IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	HARRISON et al.	:	
		:	
Serial No.	10/029,365	:	Group Art Unit 1742
		:	
Application Filed	December 20, 2001	:	Examiner: Sheehan, John P.

For: METHOD OF RESTORATION OF MECHANICAL PROPERTIES OF A CAST NICKEL-BASED SUPERALLOY FOR SERVICED AIRCRAFT COMPONENTS

DECLARATION UNDER 37 CFR § 1.132

Thomas J. Kelly, hereby certifies the following:

1. I am a joint inventor of all the claims of the patent application identified above and I am a joint inventor of the subject matter described and claimed therein.

2. I have extensive knowledge of the compositions of superalloy materials and I am familiar with trademarks of superalloy materials, as I am skilled in the art of superalloy compositions.

3. To the best of my knowledge, the trademark "Inconel 903" for a superalloy material does not exist in the art. The use of such a designation would be recognized by one skilled in the art as referring to the trademark "INCOLOY® 903," which does exist.

4. To the best of my knowledge, the trademark "Inconel 907" for a superalloy material does not exist in the art. The use of such a designation would be recognized by one skilled in the art as referring to the trademark "INCOLOY® 907," which does exist.

5. To the best of my knowledge, the trademark "Inconel 909" for a superalloy material does not exist in the art. The use of such a designation would be recognized by one skilled in the art as referring to the trademark "INCOLOY® 909," which does exist.

6. The term INCOLOY® generally is used with reference to an alloy falling in the family of iron-base superalloys.

7. The term INCONEL® generally is used with reference to an alloy falling in the family of nickel-base superalloys.

8. I have observed incorrect usages of the terms INCOLOY® and INCONEL®. Examples of such incorrect usages are available on the Internet.

9. I hereby acknowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon, and I hereby declare that all statements made in this declaration of my own knowledge are true and that all statements made on information and belief are believed to be true.

Thomas J. Kelly

Thomas J. Kelly

Nominal compositions and densities of selected cast nickel-base superalloys (continued)

Alloy	Composition, %														Density, g/cm³
	C	Cr	Co	Mo	W	Ta	Nb	Al	Ti	Hf	Zr	B	Ni	Other	
Waspaloy	0.06	19.0	12.3	3.8	—	—	—	1.2	3.0	—	0.01	0.005	bal	0.45 Mn	—
NX 188	0.04	—	—	18.0	—	—	—	8.0	—	—	—	—	bal	—	—
SEL	0.08	15.0	26.0	4.5	—	—	—	4.4	2.4	—	—	0.015	bal	—	—
CMSX-2(a)	—	8.0	4.6	0.6	8.0	6.0	—	5.6	1.0	—	—	—	bal	—	8.6
GMR-235	0.15	15.0	—	4.8	—	—	—	3.8	2.0	—	—	0.05	bal	0.3 Mn, 0.4 Si, 11.0 Fe	8.0
CMSX-3(a)	—	8.0	4.6	0.6	8.0	6.0	—	5.6	1.0	0.10	—	—	bal	—	8.6
CMSX-4(a)	—	6.4	9.6	0.6	6.4	6.5	—	5.6	1.0	0.10	—	—	bal	3.0 Re	8.7
CMSX-6(a)	—	9.9	5.0	3.0	—	2.0	—	4.8	4.7	0.05	—	—	bal	—	7.98
GMR-235	0.15	15.0	—	4.8	—	—	—	3.5	2.5	—	—	0.05	bal	4.5 Fe	8.04
SEL-15	0.07	11.0	14.5	6.5	1.5	—	0.5	5.4	2.5	—	—	0.015	bal	—	8.7
UDM 56	0.02	16.0	5.0	1.5	6.0	—	—	4.5	2.0	—	0.03	0.070	bal	0.5 V	8.2
M-22	0.13	5.7	—	2.0	11.0	3.0	—	6.3	—	—	0.60	—	bal	—	8.63
IN-731	0.18	9.5	10.0	2.5	—	—	—	5.5	4.6	—	0.06	0.015	bal	1.0 V	7.75
MAR-M 421	0.14	15.8	9.5	2.0	3.8	—	—	4.3	1.8	—	0.05	0.015	bal	—	8.08
MAR-M 432	0.15	15.5	20.0	—	3.0	2.0	2.0	2.8	4.3	—	0.05	0.015	bal	—	8.16
MC-102	0.04	20.0	—	6.0	2.5	0.6	6.0	—	—	—	—	—	bal	0.25 Si, 0.30 Mn	—
Nimocast 242	0.34	20.5	10.0	10.5	—	—	—	0.2	0.3	—	—	—	bal	1.0 Fe, 0.3 Mn, 0.3 Si	8.40
Nimocast 263	0.06	20.0	20.0	5.8	—	—	—	0.5	2.2	—	0.04	0.008	bal	0.5 Fe, 0.5 Mn	8.36

(a) Single crystal

Physical properties of cast nickel-base and cobalt-base alloys

Alloy	Density, g/cm³	Melting range		Specific heat						Thermal conductivity						Mean coefficient of thermal expansion, 10^{-6}/K(a)		
				At 21°C (70°F)		At 538°C (1000°F)		At 1093°C (2000°F)		At 93°C (200°F)		At 538°C (1000°F)		At 1093°C (2000°F)				
		°C	°F	J/kg · K	Btu/lb · °F	J/kg · K	Btu/lb · °F	J/kg · K	Btu/lb · °F	W/m · K	Btu · in./h · ft² · °F	W/m · K	Btu · in./h · ft² · °F	W/m · K	Btu · in./h · ft² · °F	At 93°C (200°F)	At 538°C (1000°F)	At 1093°C (2000°F)
Nickel base																		
IN-713 C	7.91	1260-1290	2300-2350	420	0.10	565	0.135	710	0.17	10.9	76	17.0	118	26.4	183	10.6	13.5	17.1
IN-713 LC	8.00	1290-1320	2350-2410	440	0.105	565	0.135	710	0.17	10.7	74	16.7	116	25.3	176	10.1	15.8	18.9
B-1900	8.22	1275-1300	2325-2375	—	—	—	—	—	—	(10.2)	(71)	16.3	113	—	—	11.7	13.3	16.2
Cast alloy 625	8.44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cast alloy 718	8.22	1205-1345	2200-2450	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
IN-100	7.75	12[illegible]	13[illegible]												—	13.0	13.9	18.1
IN-162	8.08	12[illegible]	13[illegible]												—	12.2	14.1	—
IN-731	7.75	[illegible]													—	—	—	—
IN-738	8.11	12[illegible]	13[illegible]											.2	189	11.6	14.0	—
IN-792	8.25	[illegible]													—	—	—	—
M-22	8.63	[illegible]													—	12.4	13.3	—
MAR-M 200	8.53	131[illegible]	13[illegible]											.7	206	—	13.1	17.0
MAR-M 246	8.44	1315-1345	2400-2450	—	—	—	—	—	—	—	—	18.9	131	30.0	208	11.3	14.8	18.6
MAR-M 247	8.53	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MAR-M 421	8.08	—	—	—	—	—	—	—	—	—	—	19.1	137	32.0	229	—	14.9	19.8

Continued

Nominal compositions of wrought iron-base superalloys (continued)

Alloy	Composition, %													
	Ni	Cr	Co	Mo	W	Nb	Al	Ti	Fe	Mn	Si	C	B	Other
Incoloy 909	38.0	—	13.0	—	—	4.7	—	1.5	42.0	—	0.4	0.01	0.001	—
N-155	20.0	21.0	20.0	3.0	2.5	1.0	—	—	30.0	1.5	0.5	0.15	—	0.15 N
V-57	27.0	14.8	—	1.3	—	—	0.3	3.0	52.0	0.3	0.7	0.08	0.010	—
19-9 DL	9.0	19.0	0.4	—	1.3	—	—	0.3	bal	1.0	0.50	0.3	—	—
16-25-6	25.5	16.25	—	6.0	—	—	—	—	bal	2.0	1.0	0.10	—	—
Pyromet CTX-1	37.7	0.1	16.0	0.1	—	3.0	1.0	1.7	39.0	—	—	0.03	—	—
Pyromet CTX-3	38.3	0.2	13.6	—	—	4.9	0.1	1.6	bal	—	0.15	0.05	0.007	—
17-14CuMo	14.0	16.0	—	2.5	—	0.4	—	0.3	62.4	0.75	0.50	0.12	—	3.0 Cu
20-Cb3	34.0	20.0	—	2.5	—	1.0	—	—	42.4	—	—	0.07	—	3.5 Cu

Nominal compositions and densities of selected cast nickel-base superalloys

Alloy	Composition, %														Density, g/cm³
	C	Cr	Co	Mo	W	Ta	Nb	Al	Ti	Hf	Zr	B	Ni	Other	
IN-718	0.04	18.5	—	3.0	—	—	5.1	0.5	0.9	—	—	—	bal	18.5 Fe	8.22
René 200	0.03	19.0	12.0	3.2	—	3.1	5.1	0.5	1.0	—	—	—	bal	—	—
IN-625	0.06	21.5	—	8.5	—	—	4.0	0.2	0.2	—	—	—	bal	2.5 Fe	—
IN-713C	0.12	12.5	—	4.2	—	—	2.0	6.1	0.8	—	0.10	0.012	bal	—	8.25
IN-713LC	0.05	12.0	—	4.5	—	—	2.0	5.9	0.6	—	0.10	0.01	bal	—	8.00
IN-713 Hf (MM 004)	0.05	12.0	—	4.5	—	—	2.0	5.9	0.6	1.3	0.10	0.01	bal	—	—
IN-100	0.18	10.0	15.0	3.0	—	—	—	5.5	4.7	—	0.06	0.014	bal	1.0 V	7.75
IN-738C	0.17	16.0	8.5	1.75	2.6	1.75	0.9	3.4	3.4	—	0.10	0.01	bal	—	8.11
IN-738LC	0.11	16.0	8.5	1.75	2.6	1.75	0.9	3.4	3.4	—	0.04	0.01	bal	—	—
IN-792	0.21	12.7	9.0	2.0	3.9	3.9	—	3.2	4.2	—	0.10	0.02	bal	—	8.25
IN-939	0.15	22.4	19.0	—	2.0	1.4	1.0	1.9	3.7	—	0.10	0.009	bal	—	8.2
B-1900	0.10	8.0	10.0	6.0	—	4.3	—	6.0	1.0	—	0.08	0.015	bal	—	8.2
B-1900 Hf (MM 007)	0.10	8.0	10.0	6.0	—	4.3	—	6.0	1.0	1.5	0.08	0.015	bal	—	8.25
B-1910	0.10	10.0	10.0	3.0	—	7.0	—	6.0	1.0	—	0.10	0.015	bal	—	—
MM 002	0.15	9.0	10.0	—	—	2.5	—	5.5	1.5	1.5	0.05	0.015	bal	—	—
MAR-M 200	0.15	9.0	10.0	—	12.5	—	1.8	5.0	2.0	—	0.05	0.015	bal	—	8.53
MAR-M 200 Hf (MM 009)	0.14	9.0	10.0	—	12.5	—	1.0	5.0	2.0	2.0	—	0.015	bal	—	—
MAR-M 246	0.15	9.0	10.0	2.5	10.0	1.5	—	5.5	1.5	—	0.05	0.015	bal	—	8.44
MAR-M 246 Hf (MM 006)	0.15	9.0	10.0	2.5	10.0	1.5	—	5.5	1.5	1.4	0.05	0.015	bal	—	—
MAR-M 247 (MM 0011)	0.16	8.5	10.0	0.65	10.0	3.0	—	5.6	1.0	1.4	0.04	0.015	bal	—	8.53
CM 247LC	0.07	8.1	9.3	0.5	9.5	3.0	—	5.6	0.7	1.4	0.01	0.015	bal	—	—
René 41	0.08	19.0	10.5	9.5	—	—	—	1.7	3.2	—	0.01	0.005	bal	—	—
René 77	0.08	15.0	18.5	5.2	—	—	—	4.25	3.5	—	—	0.015	bal	—	7.91
René 80	0.17	14.0	9.5	4.0	4.0	—	—	3.0	5.0	—	0.03	0.015	bal	—	8.16
René 80 Hf	0.15	14.0	9.5	4.0	4.0	—	—	3.0	4.7	0.8	0.01	0.015	bal	—	—
René 100	0.15	9.5	15.0	3.0	—	—	—	5.5	4.2	—	0.06	0.015	bal	1.0 V	7.75
René 125 Hf (MM 005)	0.10	9.0	10.0	2.0	7.0	3.8	—	4.8	2.6	1.6	0.05	0.015	bal	—	—
Nimocast 75	0.12	20.0	—	—	—	—	—	—	0.5	—	—	—	bal	—	8.44
Nimocast 80	0.05	19.5	—	—	—	—	—	1.4	2.3	—	—	—	bal	1.5 Fe	8.17
Nimocast 90	0.06	19.5	18.0	—	—	—	—	1.4	2.4	—	—	—	bal	1.5 Fe	8.18
Nimocast 95	0.07	19.5	18.0	—	—	—	—	2.0	2.9	—	0.02	0.015	bal	—	—
Nimocast 100	0.20	11.0	20.0	5.0	—	—	—	5.0	1.5	—	0.03	0.015	bal	—	—
Udimet 500	0.08	18.5	16.5	3.5	—	—	—	3.0	3.0	—	—	0.006	bal	—	8.02
Udimet 700	0.08	14.3	14.5	4.3	—	—	—	4.25	3.5	—	0.02	0.015	bal	—	—
Udimet 710	0.13	18.0	15.0	3.0	1.5	—	—	2.5	5.0	—	0.08	—	bal	—	8.08
C 130	0.04	21.5	—	10.0	—	—	—	0.8	2.6	—	—	—	bal	—	—
C 242	0.30	20.0	10.0	10.3	—	—	—	0.1	0.2	—	—	—	bal	—	—
C 263	0.06	20.0	20.0	5.9	—	—	—	0.45	2.15	—	0.02	0.001	bal	—	—
C 1023	0.15	15.5	10.0	8.0	—	—	—	4.2	3.6	—	—	0.006	bal	—	—
Hastelloy X	0.08	21.8	1.5	9.0	0.6	—	—	—	—	—	—	—	bal	18.5 Fe, 0.5 Mn, 0.3 Si	—
Hastelloy S	0.01	16.0	—	15.0	—	—	—	0.40	—	—	—	0.009	bal	3.0 Fe, 0.02, La, 0.65 Si, 0.55 Mn	—

Chemical compositions of some nickel-base P/M superalloys (continued)

Alloy	Composition, %													
	C	Ni	Cr	Co	Mo	W	Ta	Nb	Hf	Al	Ti	V	B	Zr
New alloys														
RSR 103	—	bal	—	—	15.0	—	—	—	—	8.4	—	—	—	—
RSR 104	—	bal	—	—	18.0	—	—	—	—	8.0	—	—	—	—
RSR 143	—	bal	—	—	14.0	—	6.0	—	—	6.0	—	—	—	—
RSR 185	0.04	bal	—	—	14.4	6.1	—	—	—	6.8	—	—	—	—

Nominal compositions of selected cast cobalt-base superalloys

Alloy	Composition, %													Density, g/cm³
	C	Cr	Ni	W	Ta	Nb	Mo	Ti	B	Zr	Fe	Co	Other	
HS-21 (MOD Vitallium)	0.25	27.0	3.0	—	—	—	5.0	—	—	—	1.0	bal	—	—
HS-31 (X-40)	0.50	25.0	10.0	7.5	—	—	—	—	—	0.17	1.5	bal	0.4 Si	—
HS-25 (L-605)	0.10	20.0	10.0	15.0	—	—	—	—	—	—	—	bal	—	—
ML-1700	0.2	25.0	—	15.0	—	—	—	—	0.4	—	—	bal	—	—
WI-52	0.42	21.0	1.0 max	11.0	—	2.0	—	—	—	—	2.0	bal	—	8.88
MAR-M 302	0.85	21.5	—	10.0	9.0	—	—	0.2	0.005	—	1.5 max	bal	—	9.21
MAR-M 322	1.0	21.5	—	9.0	4.5	—	—	0.75	—	2.25	0.75	bal	—	8.91
MAR-M 509	0.60	24.0	10.0	7.0	7.5	—	—	0.2	—	—	1.0	bal	—	8.85
AiResist 13	0.45	21.0	—	11.0	—	2.0	—	—	—	—	2.5 max	bal	3.4 Al, 0.1 Y	8.43
AiResist 215	0.35	19.0	0.5	4.5	7.5	—	—	—	—	0.13	—	bal	4.3 Al, 0.1 Y	8.47
F 75	0.25	28.0	1.0 max	—	—	—	5.5	—	—	—	—	bal	—	—
FSX-414	0.25	29.5	10.5	7.0	—	—	—	—	0.012	—	2.0 max	bal	—	8.3
X-45	0.25	25.5	10.5	7.0	—	—	—	—	0.010	—	2.0 max	bal	—	—

Nominal compositions of wrought cobalt-base superalloys

Alloy	Composition, %													
	Ni	Cr	Co	Mo	W	Ta	Nb	Al	Fe	Mn	Si	C	Zr	Other
AirResist 213	—	19	66	—	4.7	6.5	—	3.5	—	—	—	0.18	0.15	0.1 Y
Elgiloy	15	20	40	7	—	—	—	—	bal	2	—	0.1	—	0.04 Be
Haynes 188	22.0	22.0	39.2	—	14.0	—	—	—	3.0	—	—	0.10	—	—
L-605	10.0	20.0	52.9	—	15.0	—	—	—	—	—	—	0.05	—	—
MAR-M 918	20.0	20.0	52.5	—	—	7.5	—	—	—	—	—	0.05	0.10	—
MP35N	35.0	20.0	35.0	10.0	—	—	—	—	—	—	—	—	—	—
MP159	25.5	19.0	35.7	7.0	—	—	0.6	0.2	9.0	—	—	—	—	3.0 Ti
Stellite 6B	3.0	30	bal	1.5	4.5	—	—	—	3.0	2.0	2.0	1.1	—	—
Haynes 150	—	28	50.5	—	—	—	—	—	bal	—	0.75	—	—	0.02 P, 0.002 S
S-816	20.0	20.0	bal	4.0	4.0	—	4.0	—	3.0	1.20	—	0.40	—	—
V-36	20.0	25.0	bal	4.0	—	—	2.3	—	2.4	1.0	—	0.32	—	—

Nominal compositions of wrought iron-base superalloys

Alloy	Composition, %													
	Ni	Cr	Co	Mo	W	Nb	Al	Ti	Fe	Mn	Si	C	B	Other
A-286	26.0	15.0	—	1.3	—	—	0.2	2.0	54.0	1.3	0.5	0.05	0.015	—
Discaloy	26.0	13.5	—	2.7	—	—	0.1	1.7	54.0	0.9	0.8	0.04	0.005	—
Alloy 901	42.5	12.5	—	5.7	—	—	0.2	2.8	36.0	0.1	0.1	0.05	0.015	—
Haynes 556	20.0	22.0	20.0	3.0	2.5	0.1	0.3	—	29.0	1.5	0.4	0.10	—	0.2 N, 0.02 La, 0.9 Ta
Incoloy 800	32.5	21.0	—	—	—	—	0.4	0.4	46	0.8	0.5	0.05	—	—
Incoloy 801	32.0	20.5	—	—	—	—	—	1.1	44.5	0.8	0.5	0.05	—	—
Incoloy 802	32.5	21.5	—	—	—	—	—	—	46	0.8	0.4	0.04	—	—
Incoloy 807	40.0	20.5	8.0	0.1	5.0	—	0.2	0.3	25	0.50	0.40	0.05	—	—
Incoloy 825	38-46	19.5-23.5	—	2.5-3.5	—	—	0.2	0.6-1.2	22	1.0	0.5	0.05	—	1.5-3 Cu, 0.03 S
Incoloy 903	38.0	—	15.0	—	—	3.0	0.7	1.4	41.0	—	—	—	—	—
Incoloy 907	38	—	13	—	—	4.7	0.03	1.5	42	—	0.15	—	—	—

Continued